October 15,2002

MEMORANDUM TO: Richard Laufer, Section Chief
Project Directorate I
Division of Licensing and Project Management, NRR

FROM: F. Mark Reinhart, Section Chief/**RA**/
Probabilistic Safety Assessment Branch
Division of Systems Safety and Analysis, NRR

SUBJECT: EVALUATION OF THE RISK ASSESSMENT INFORMATION PROVIDED BY CALVERT CLIFFS NUCLEAR POWER PLANT IN SUPPORT OF ITS REQUEST TO DECREASE THE SURVEILLANCE TESTING INTERVAL FOR VERIFYING BORON CONCENTRATION IN THE SAFETY INJECTION TANKS FROM ONCE EVERY 31 DAYS TO ONCE EVERY SIX MONTHS (TAC #MB3974 and #MB3975)

The Probabilistic Safety Assessment Branch (SPSB) reviewed the risk assessment information submitted by Calvert Cliffs Nuclear Power Plant (CCNPP) in support of its request to modify SR 3.5.1.4 to change the method for verifying boron concentration in the safety injection tanks (SITs). The current method is to take a sample from each tank and analyze the boron concentration every 31 days. The proposed method would extend the frequency of taking a sample from once every 31 days to once every six months but, at the same time, would require monitoring inleakage to the tanks every 12 hours based on SIT level changes.

SPSB concludes that the risk information included in the CCNPP application supports the proposed change. The SPSB input to the safety evaluation (SE) is attached.

Attachment: As stated

CONTACT: Nick Saltos SPSB
415-1072

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Attachment: As stated

CC: Donna Skay
Lambros Lois

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DATE	10/10/02	10/15/02

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EVALUATION OF THE RISK ASSESSMENT INFORMATION PROVIDED BY CALVERT CLIFFS NUCLEAR POWER PLANT IN SUPPORT OF ITS REQUEST TO DECREASE THE SURVEILLANCE TESTING INTERVAL FOR VERIFYING BORON CONCENTRATION IN THE SAFETY INJECTION TANKS FROM ONCE EVERY 31 DAYS TO ONCE EVERY SIX MONTHS (TAC #MB3974 and #MB3975)

1.0 INTRODUCTION AND BACKGROUND

By letter dated January 31, 2002, Calvert Cliffs Nuclear Power Plant (CCNPP) submitted a license amendment application requesting NRC review and approval of a proposed change to Technical Specification (TS) 3.5.1 “Safety Injection Tanks (SITs)” and related Bases. Specifically, the proposed change would revise Surveillance Requirement (SR) 3.5.1.4 which requires that the boron concentration of each SIT be verified every 31 days, by sampling, to be within TS limits (i.e., between 2300 ppm and 2700 ppm).

The primary safety function of the four SITs is to inject large quantities of borated water into the reactor vessel during the blowdown phase of a large loss-of-coolant accident (LOCA) and to provide inventory to help accomplish the refill phase that follows the blowdown phase. Boron concentration is controlled in the SITs to prevent either excessive or insufficient boron concentrations. Post-LOCA emergency procedures, directing the operator to establish simultaneous hot and cold leg injection, are based on the worst case minimum boron precipitation time. Maintaining the SIT boron concentration within the upper limit, which is 2700 ppm for Calvert Cliffs, ensures that the borated water sources used for injection during a LOCA would not result in boron precipitation earlier than predicted by the design basis calculation. The minimum boron concentration requirement, which is 2300 ppm for Calvert Cliffs, is based on beginning-of-life reactivity values selected to ensure that the reactor will remain subcritical during the reflood stage of a large break LOCA. During a large LOCA, all control element assemblies (CEAs) are assumed not to insert into the core, and the initial reactor shutdown is accomplished by void formation during blowdown. Sufficient boron concentration must be maintained in the SITs to prevent a return to criticality during the reflood stage of the LOCA.

The proposed change will decrease the frequency of verifying boron concentration by sampling from once every 31 days to once every six months. This change would decrease the frequency of entering the containment to take samples. According to CCNPP, these containment entries are the largest contributor to non-outage routine occupational exposure. CCNPP used both engineering analyses and risk insights to support the acceptability of the proposed change.

2.0 REQUESTED CHANGE

CCNPP proposes to modify SR 3.5.1.4 to change the method for verifying boron concentration in the SITs. The current method is to take a sample from each tank and analyze the boron concentration every 31 days. The proposed method would extend the frequency of taking a sample from once every 31 days to once every six months but, at the same time, would require monitoring inleakage to the tanks every 12 hours based on SIT level changes. Inleakage monitoring limits are established based on conservative calculations which assume that all level changes are due to unborated water leaking into the SITs.

3.0 EVALUATION OF RISK INFORMATION

The licensee assessed the risk impact associated with a potential increase in the likelihood of boron concentration falling bellow the minimum requirement of 2300 ppm because of the proposed reduction in the surveillance testing frequency by sampling. The two mechanisms by which the boron concentration in the SITs can decrease are precipitation and dilution. Precipitation occurs when the solution of borated water becomes so saturated that the boron settles out of the solution. Since the boron concentration in the SITs is well below the solubility limit of boric acid, boron concentration reduction through precipitation is precluded. Dilution occurs through the addition of water containing a lower boron concentration than the SITs. The proposed requirement to monitor inleakage to the tanks every 12 hours, based on SIT level changes, will limit significantly the likelihood of boron concentration reduction through dilution (verification by sampling is also required if 10 inches of accumulated inleakage is found in any SIT). Two realistic scenarios that would reduce the boron concentration through dilution are: (1) operator failure to monitor inleakage to the tanks; and (2) the possibility of leakage out of the tank which masks the leakage into the tank (i.e., boron dilution can occur without a detectable level change in the SITs).

The licensee did not assess the risk impact associated with a potential increase in the likelihood of not detecting the existence of a high boron concentration in the SITs (above 2700 ppm) because of the proposed reduction in the surveillance testing frequency by sampling. However, the staff finds that this risk impact is insignificant because the boron concentration of the water added to the SITs from the refueling water storage tank, whose boron concentration is controlled by TS, is also sampled at the discharge of the high pressure safety injection (HPSI) pump. Such sampling ensures that the water being added to the SITs is within the required boron concentration limits prior to being added.

3.1 Objectives and Evaluation Criteria

An acceptable approach to risk-informed decision making is to show that the proposed change to the TS meets several key principles defined in Regulatory Guide 1.174. One of these principles is to show that if the proposed change results in an increase in risk, in terms of core damage frequency (CDF) and large early release frequency (LERF), this increase is small and consistent with the Commission's Safety Goal Policy Statement. Acceptance guidelines for meeting this principle are presented in Regulatory Guide 1.174. The licensee's analysis follows the approach outlined in Regulatory Guide 1.174. The mean yearly increases in CDF and LERF, due to the proposed change, were assessed and compared to the acceptance guidelines of RG 1.174. Also, the approach used to assess the change in the unavailability of the SITs to provide borated water with concentration above 2300 ppm due to the proposed change in the surveillance testing interval, is consistent with guidance provided in Regulatory Guide 1.177.

In addition, the staff reviewed the quality of the submitted risk assessment to ensure that (1) no risk significant scenarios have been omitted and (2) the assumptions made and data used in the analysis are realistic or conservative.

3.2 Risk Impact of Proposed Change

The licensee assessed this risk impact (i.e., the risk associated with SIT boron dilution bellow the minimum requirement of 2300 ppm due to the proposed change) as the product of three terms: (1) the frequency of a large LOCA; (2) the probability of failure to insert all CEAs given a large LOCA; and (3) the increase in the likelihood of boron concentration falling bellow the minimum requirement of 2300 ppm (i.e., the increase in the unavailability of the SITs to inject borated water of adequate boron concentration to prevent a return to criticality during the reflood stage of the LOCA given all CEAs failed to insert). In addition to the base case estimate of the risk impact, sensitivity studies were performed to assess the potential impact of uncertainties on the results and ensure that any potential risk increase associated with the proposed TS change is small and within the guidelines provided in RG 1.174.

The following major considerations and assumptions were used in the assessment:

– The mean large break LOCA frequency at Calvert Cliffs was assessed to be about 2.0E-6 per year. This frequency was derived from the mean value of 5.0E-6 per year reported in NUREG/CR-5750, Rates of Initiating Events at U.S. Nuclear Power Plants: 19
+87-1995, and adjusting for the smaller range of large break LOCA sizes at Calvert Cliffs (the CCNPP large LOCA frequency is based on break sizes between 9.57" and double-ended rupture while the NUREG/CR-5750 large LOCA frequency is based on break sizes between 6" and double-ended rupture).

– Since the probability of failure to insert all CEAs depends on the size of the break, this probability was logarithmically interpolated for the entire break range assuming it is 50% for a double-ended rupture and negligible (1E-6) for the smallest large LOCA break. The uncertainty associated with this assumption was addressed by a sensitivity study which assumes that all CEAs will fail to insert during a large LOCA, independently of size.

– The unavailability of the SITs to inject borated water of adequate boron concentration (i.e., 2300 ppm or more) into the RCS was conservatively assessed to be 2% when the surveillance testing frequency by sampling is changed to once every six months (an increase of about an order of magnitude, from 0.2% to 2%, with respect to the case of monthly testing). This unavailability was based on actual data from the current monthly sampling tests which took place since the soft seat SIT discharge check valves were replaced with hard seats in the 1997 refueling outage for Unit 2 and the 1998 refueling outage for Unit 1. This replacement reduced the amount of leakage into the SITs. The information from over 350 actual data points indicates that the boron concentration never fell below 2300 ppm. Actual boron concentration changes, from the monthly sampling data points, were used to predict boron concentration changes that would have occurred if the sampling tests were performed every six months, as proposed, and without any boron concentration changes made by the operators (i.e., without any information from the monthly sampling tests). These projected boron concentration changes indicated that if the sampling tests had been performed every six months, the boron concentration would still not have fallen bellow the minimum required by the TS

(i.e., 2300 ppm). Even though actual experience indicates that with a six-month surveillance interval none of the samples would fall below 2300 ppm, the conservative calculation used in the risk analysis predicts a 2% probability of boron concentration being bellow 2300 ppm when the SITs are demanded. It is also important to point out that in the calculation of the 2% probability no credit was taken for the operators' ability to monitor the SIT level changes (proposed to take place every 12 hours) and take appropriate action.

The staff finds that the assumptions made and data used in the analysis produced the following results which can safely be used to draw conclusions about the proposed change.

Increase in CDF (base case): 2.0E-9/year

Increase in LERF (base case): Smaller than 2.0E-9/year (was not calculated)

Increase in CDF (all CEAs fail to insert during LOCA): 4.0E-8/year

Increase in LERF (all CEAs fail to insert during LOCA): Smaller than 4.0E-8/year

The results of the licensee's analysis indicate that the mean yearly increases in CDF and LERF due to the proposed change would be well below the RG 1.174 acceptance guidelines which are 1E-6/yr and 1E-7/yr, respectively, even when the sensitivity case assuming no CEA insertion during a large LOCA is considered.

In addition, the licensee committed to track the reliability of the SITs based on boron concentration from SIT samples under the Maintenance Rule, against appropriate goals. This provides extra assurance that the current availability of SITs to provide borated water with boron concentration above the minimum TS limit, as indicated by samples taken since check valve seat replacement, will be maintained even in the unlikely event of future valve leakage out of the tank which masks the leakage into the tank (i.e., boron dilution would occur without a detectable level change in the SITs).

3.3 PRA Quality

The risk assessment, performed by the licensee in support of the proposed change to the design basis, is not based on accident scenarios that have been modeled in the plant's PRA. Therefore, the "quality" of the plant PRA does not have a significant impact on the "quality" of the submitted risk assessment. The "quality" of the submitted risk assessment has been addressed and documented in this Section of the Safety Evaluation (SE).

4.0 SUMMARY AND CONCLUSION

The staff reviewed the risk assessment information submitted by CCNPP in support of its request to modify SR 3.5.1.4 to change the method for verifying boron concentration in the SITs. The current method is to take a sample from each tank and analyze the boron concentration every 31 days. The proposed method would extend the frequency of taking a

sample from once every 31 days to once every six months but, at the same time, would require monitoring inleakage to the tanks every 12 hours based on SIT level changes. The results of the licensee's risk analysis indicate that the mean yearly increases in CDF and LERF due to the proposed change would be well below the RG 1.174 acceptance guidelines which are 1E-6/yr and 1E-7/yr, respectively. In addition, the licensee committed to track the reliability of the SITs based on boron concentration from SIT samples under the Maintenance Rule, against appropriate goals. Therefore, the staff concludes that the risk information included in the CCNPP application supports the proposed change.